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(54) Communications system

(57) A communication system comprising a number of base-stations (2) connected to a network of exchanges (1); in which portable transceivers (3) are capable, when within range, of communicating with any base-station (2) for the purposes of sending and receiving calls over the network; and in which a control means (4 and 5) is arranged to receive and record identification signals transmitted by the users from the portable transceivers via the base-stations, so that incoming calls to the portable tranceivers can be directed to the appropriate base-stations.

Details of the charging rates; call handling when the portable transceivers are not accessible; and a numbering system for the portable transceivers, are also given.

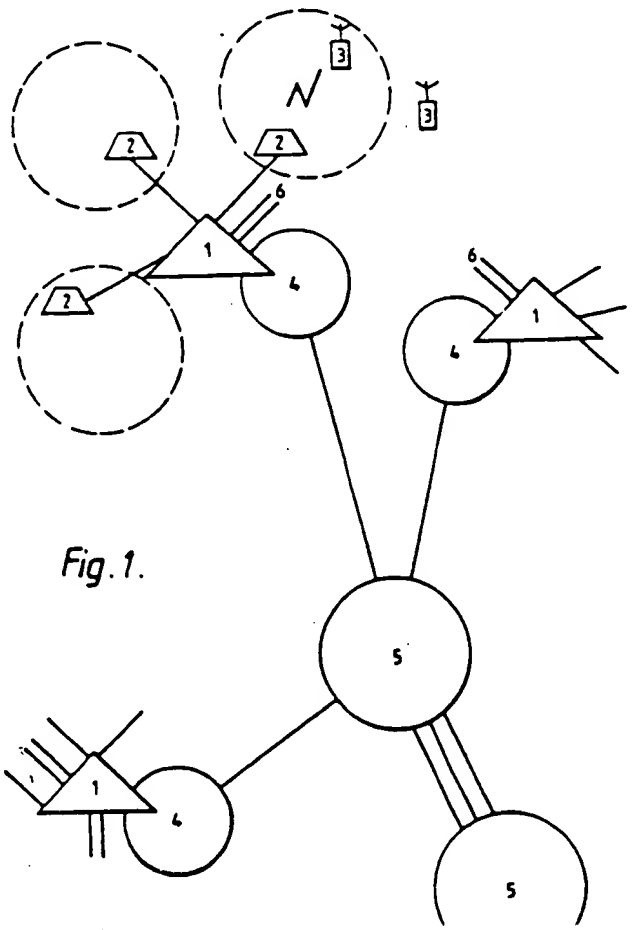

Fig. 1.

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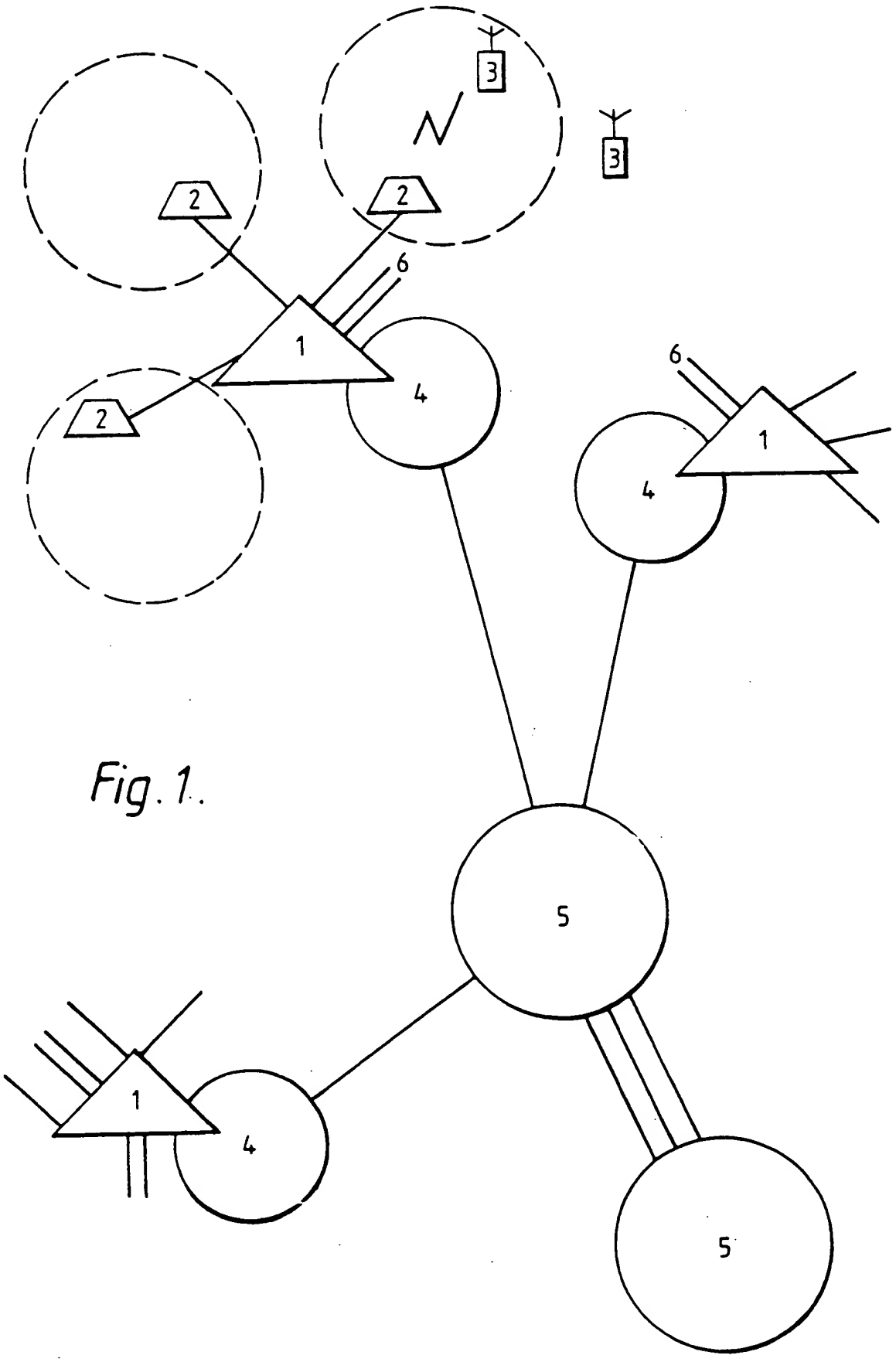
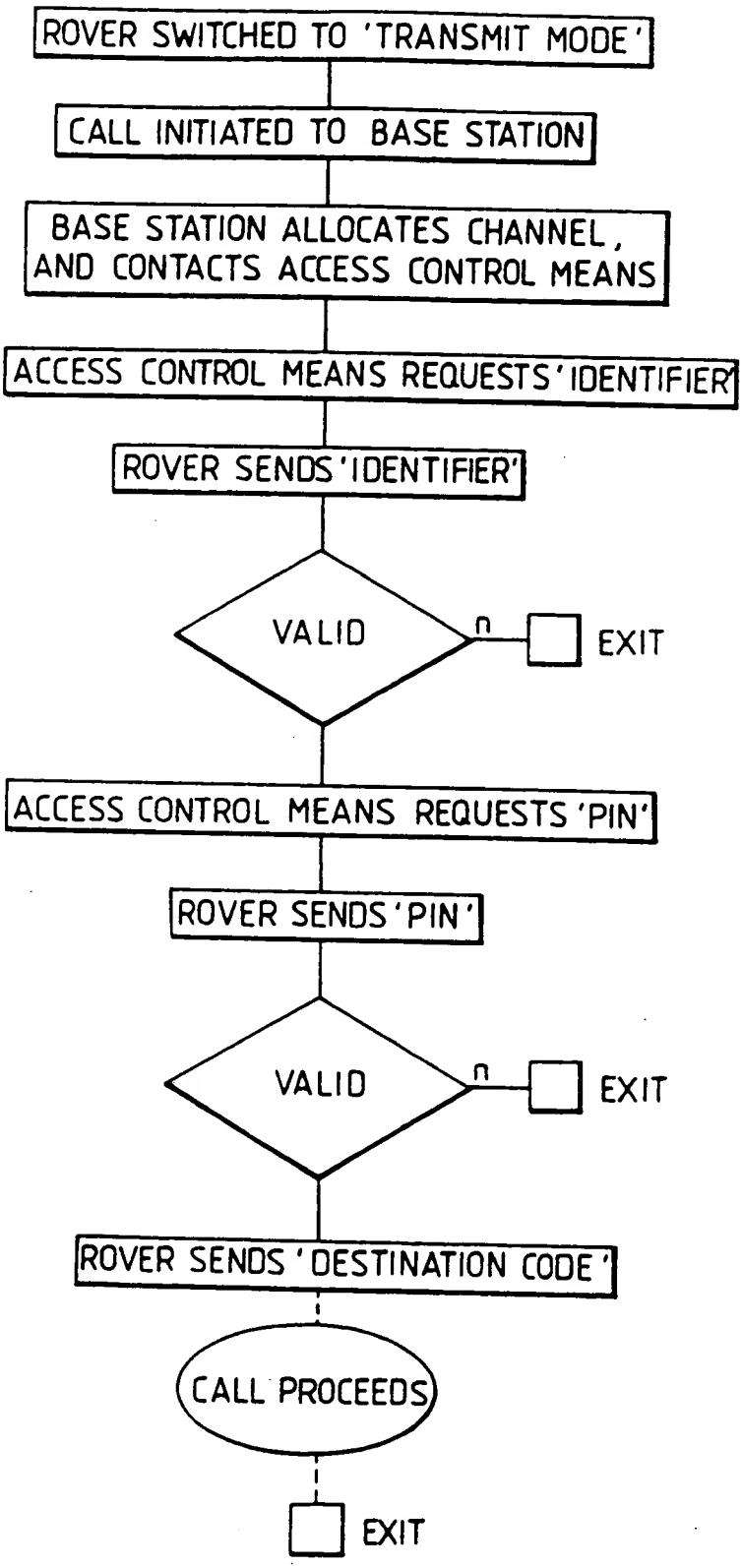


Fig. 1.

Fig. 2.

OUTGOING-CALL PROGRESSION CHART.



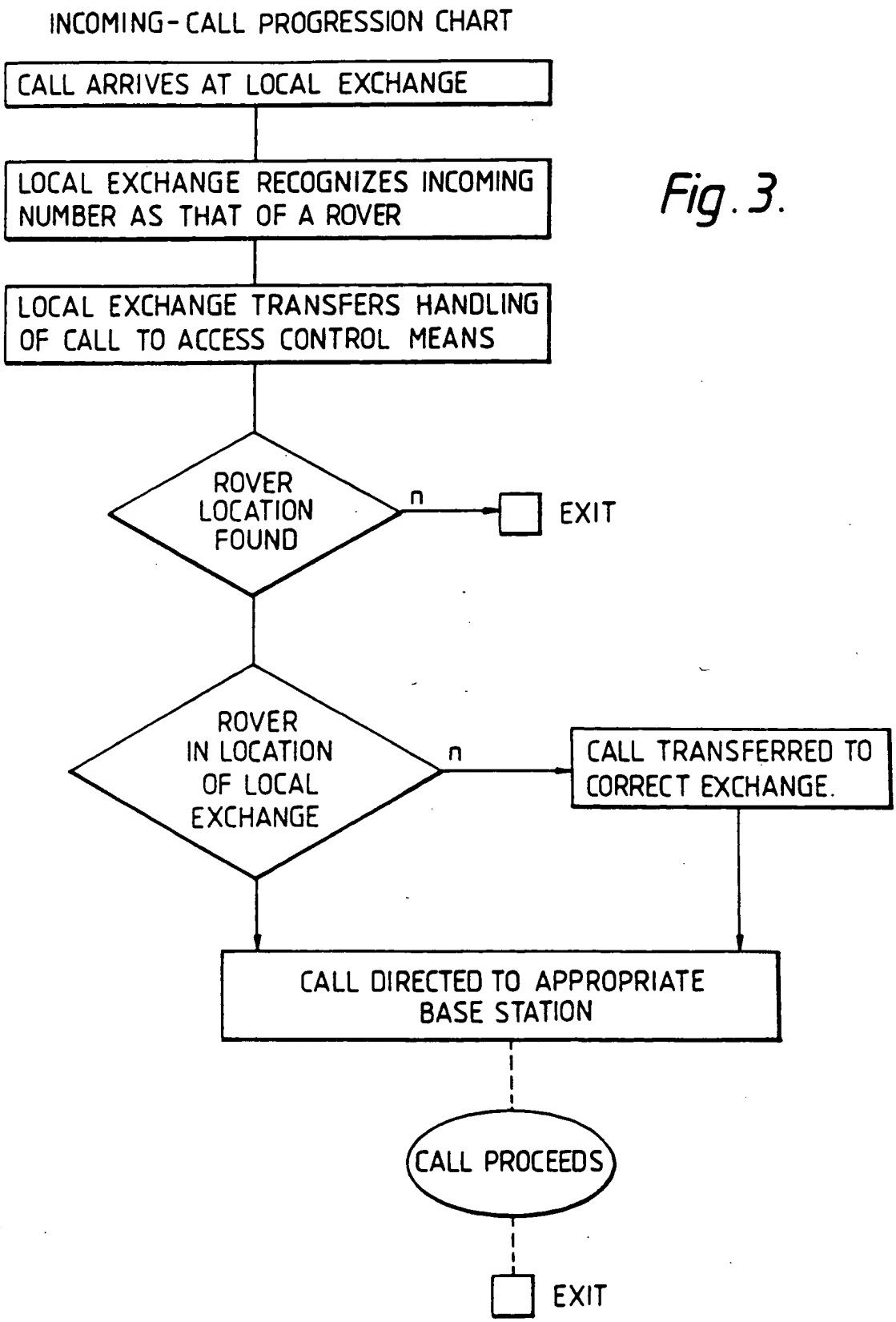

INCOMING-CALL PROGRESSION CHART
CALL ARRIVES AT LOCAL EXCHANGE
LOCAL EXCHANGE RECOGNIZES INCOMING NUMBER AS THAT OF A ROVER
LOCAL EXCHANGE TRANSFERS HANDLING OF CALL TO ACCESS CONTROL MEANS
ROVER LOCATION FOUND
n
EXIT
ROVER IN LOCATION OF LOCAL EXCHANGE
n
CALL TRANSFERRED TO CORRECT EXCHANGE.
CALL DIRECTED TO APPROPRIATE BASE STATION
CALL PROCEEDS
EXIT

Fig. 3.

whereby calls to portable transceivers can be directed to the appropriate base-station.

2. A communications system according to claim 1 in which each portable transceiver is arranged only in response to operation of manually cperable controls thereof to transmit the identification signal;

3. A communications system according to Claim 1 or 2 in which the control means comprises a plurality of control centres.

4. A communications system according to claim 3 in which each base-station is assigned to a particular control centre, and each control centre is arranged to record the identities of the portable transceivers from which signals have been received by its assigned base-station(s).

5. A communications system according to claim 3 or 9 in which each portable transceiver is assigned to a particular base-station; each control centre is common to a plurality of exchanges via which base-stations are connected to the network; each such exchange includes local control means arranged to store information identifying, in respect of each of the transceivers assigned to the base-stations connected to that exchange, which of those base-stations (if any) has received an identifying signal from that transceiver; and each such exchange is operable upon receipt of a call for a transceiver to direct it to the base-station thus identified and, if no such station is identified, to transfer control to the nearest control centre.

6. A communications system according to claim 5 in which the exchange is arranged in the event that no such station is identified to transmit to the caller an audible indication that a higher call charge will apply to the call, if successful.

7. A communcations system according to claim 3 in which each portable transceiver is assigned to a particular base-station; each base-station is assigned to a particular control centre, and each control centre is arranged, upon receipt of an identification signal, to forward the identity of the portable transceiver originating that identification signal and the identity of the base-station within range of that portable transceiver to the control centre to which the base-station is assigned to which that portable transceiver is assigned, where the identities are recorded.

8. A communications system according to claim 7 in which each control centre is ccmmon to a plurality of exchanges via which the base-stations are connected to the network; each such exchange includes local control means arranged to store information identifying, in respect of each of the transceivers assigned to the base-stations connected to that exchange, which base-station (if any) has received an identifying signal from that transceiver is operable upon receipt of a call for a transceiver to direct it to the base-station thus identified and, if no such station is identified, to transmit to the caller an audible indication that the transceiver is not currently accessible.

9. A communications system according to any one of the preceding claims including additional portable transceivers having means for automatic periodic transmission of identification signals, the control means being arranged to record the progress of those transceivers from base-station to base-station.

10. A communications system according to any one of the preceding claims in which each portable transceiver includes manually selectable means for the actuation of means for inhibiting the receipt of incoming calls other than those including a particular code.

11. A communications system according to claim 10 in which the particular code is the calling party's telephone number.

12. A communications system according to claim 10 or 11 in which the inhibiting means is located in the portable transceiver.

13. A communications system according to claim 10 or 11 in which the inhibiting means is located in the control means or in a telephone exchange to which is connected a base-station to which the transceiver is assigned.

14. A communications system according to any one of the preceding claims including means responsive to a call to a transceiver not currently accessible to record at the caller's option an indication of the caller's identity and to forward it to the portable transceiver when an identification signal from the latter is next received.

15. A communications system according to any of the preceding claims including means responsive to a call to a transceiver not currently accessible to record at the caller's option an indication of the caller's identity and to notify the caller when an identification signal from the portable transceiver is next received.

16. A communications system according to any one of the preceding claims including means responsive to a call to a transceiver not currently accessible to record at the caller's option an indication of the caller's identity and to automatically re-establish the call when an identification signal from the portable transceiver is next received.

17. A communications system according to any one of the preceding claims in which each portable transceiver is assigned to a base-station, and each portable transceiver is allocated a telephone number which forms part of the numbering scheme used for fixed telephone lines in that it is accessible from telephones connected to fixed lines of the network by the use of the same dialling code prefixes as are required for access to fixed telephone lines connected to the same exchange as the assigned base-station

or local controller responsible for the base-station forwarding it.

In a preferred embodiment the local controller stores location information collected by the base-stations it is responsible for, and the district controller also stores location information collected by all the base-stations it is responsible for. When handling an incoming call the local controller first attempts to locate a base-station in its area of coverage through which to communicate with the destination rover, and only if this attempt is unsuccessful transfers call handling to the district controller. The district controller uses any additional location information it has, to attempt to locate the rover in a wider area of coverage. If the district controller is also unsuccessful it may transfer call handling to the next district controller, or the next tier of control.

In an alternative embodiment all the location information collected by the access control means is automatically passed to the local controller responsible for the 'home' base-station of the rover from which the information originates. This has the advantage that the local controller can locate the rover (if it is able to receive incoming calls) without transferring call handling.

It should be appreciated that much of the access control means can be implemented using the data processing capability of existing exchanges.

Whenever a rover makes a call, billing information is collected and used to charge for the calls made. It is preferred that an audible indication that a higher charge rate will apply is transmitted to the caller, if a destination rover is not located at a base-station covered by the exchange responsible for the line to its 'home' base-station; and before the call is diverted to another exchange.

It is preferred that some rovers will have the ability, when in LISTEN mode, to automatically transmit 'location' signals at regular intervals. This is particularly useful for rovers used by customers who are highly mobile, eg salesmen, since it allows the access control means to record the progress of the rover from base-station to base-station without the need for the customer to continually make entries on the keypad.

The 'call number' of a rover, ie the number which must be dialled to call a rover, may be an ordinary telephone number which forms part of the numbering scheme used for fixed telephone lines. In this way rovers will be accessible, from telephones connected by fixed lines of the network or other rovers, by using the same dialling code prefixes as are required for access to fixed telephone lines connected to the same exchange as the destination rover's 'home' base-station.

A useful feature that can be incorporated into the rover is the ability to operate in a this mode only urgent incoming calls are accepted, for instance calls containing a special code. The special code may be a particular telephone number, and in this case only calls from that telephone/rover will be accepted. The means for providing this feature may be installed in the rover, or alternatively be provided by the access control means or in the exchange responsible for the 'home' base-station.

When a destination rover cannot be located the system can be arranged to respond in a more intelligent manner than merely advising the caller that the destination rover is unobtainable. For example, the caller's identity may be recorded and forwarded to the destination rover when a 'location' signal is next received. Or the caller's identity may be recorded and the caller advised, say by a voice announcement, when a 'location' signal is next received. Or the call could automatically be connected when a 'location' signal is next received.

A further useful feature is the provision of means whereby a customer may elect to have incoming calls to a fixed telephone redirected to a rover. This feature may be used by a customer so that he can receive calls at the fixed telephone on his desk when he is there and via a rover when he is absent from his home or workplace. Alternatively the customer may be able to elect to have incoming calls to the fixed telephone redirected to any of several rovers, perhaps of his colleagues, or members of his family, and the caller will be able to select to which rover the call is to be redirected.

It should be appreciated that although the embodiment of the invention has been described with reference to a telephone network, any network used for communications would be able to support an embodiment of the invention. Also although the description has consistently referred to communication between the rovers and base-stations as being by means of radio links, other media can be used, for example infra-red, ultrasonics, or even a plug-in wire link.

CLAIMS

1. A communications system comprising a plurality of base-stations connected to a network; a plurality of portable transceivers each capable of communication with any one of the base-stations when within range thereof; control means for recording the location of portable transceivers in which: each portable transceiver is arranged to transmit an identification signal; each base-station is arranged to forward received identification signals to the control means; and the control means is arranged upon receipt of an identification signal to record the identity of the base-station within range of which the portable transceiver origi-

in a public environment.

The rovers could operate in one of several modes, for example: OFF Mode, or powered down mode, when the customer does not wish to make or receive calls; LISTEN mode when the customer is available to receive incoming calls; and TRANSMIT mode when the customer is engaged in a call.

The access control means handles the establishment of calls to and from the rovers. In the case of a call from a rover (see Figure 2): first the rover is switched to TRANSMIT mode which automatically causes a "transmit request" signal, containing part of the identifier to be sent to the nearest base-station over any channel available to the rover that is perceived to be quiet. The base-station responds by allocating a radio channel to the rover for further use, and contacting the access control means, ie the most locally devolved controller (e.g. 4). That local controller then takes over handling of the call and asks the rover to send (via the base-station) its entire identifier. The 'home' base-station information in the identifier is used by that local controller to determine which controller has a record of that rover each controller has a record of the identifiers of all the rovers having 'home' base-stations within its area of coverage. The relevant controller is then contacted to validate the identifier; of course, if the rover is calling via its 'home' base-station the local controller concerned will be able to determine validity itself. If the identifier is found to be valid the local controller requests the rover's user to send a personal identify number (PIN). The PIN is the customers personal identification. Once this has been correctly entered the controller will send a dialling tone signal to the rover and the destination code ('phone number) can be entered. The call is routed through the exchanges over the telephone network in the normal way and the call proceeds.

In the case of incoming calls the situation is complicated by the need to determine whether the destination rover is able to receive the call, and if so the appropriate base-station must be located. The 'call number' of a rover, ie the number which must be dialled to call to a rover, need not contain the destination rover's identifier. However, it must contain, like any telephone number, sufficient information to enable the call to be routed to the exchange responsible for the line to the destination rover's 'home' base-station; in addition it must contain information identifying the call's destination as a particular rover, when the call arrives at the exchange responsible for the line to the destination rover's 'home' base-station, the incoming number is recognised by the exchange as that of a rover and call handling is transferred to the access control means, ie the controller responsible for the 'home' base-means must locate the base-station, if it exists, through which communication with the rover is currently possible. The access control means at large collects information about the location of all the rovers; this information is under the customers' control and is collected as follows: when a customer is in a place where he wishes to receive calls he makes an entry on the rover's keypad, eg by switching (from OFF) to LISTEN or TRANSMIT mode, which causes the rover to transmit a 'location' signal, over any channel avilable to the rover that is perceived to be quiet, containing information identifying the rover and its 'home' base-station (ie at least part of the identifier).

Provided a base-station receives this signal, it responds by acknowledging the 'location' signal and forwarding 'location' information, identifying itself and the rover, to the access control means. This information may be stored temporarily, and deleted when the next 'location' signal is received; or alternatively it may be stored permanently, by entering further instructions via the rover, as a record of a likely location of that rover, perhaps for use at certain times of the day eg 9.00am—5.00pm office location; 7.00pm to 7.00am home.

This method of tracking the location of rovers has considerable advantages over previous methods since it is under the control of the user, and can be altered instantly to suit special circumstances; it restricts the search areas to manageable numbers; there is no need for base-stations to emit beacons; the user does not need to know which base-station he is using; and the procedure offers a basis for charging economic rents based on the number and distance of base-stations which have to be polled.

When handling an incoming call the controller responsible for the 'home' base-station of the destination rover will be able to determine from the incoming number the destination rover's identifier. Using this the access control means will attempt to locate a base station through which communication with the destination rover is currently possible, for example by polling: firstly to the last known location, unless this was more than several hours ago; secondly to the 'home' base-station (this can be determined from the identifier); thirdly to base stations recorded as likely locations. If the rover is not found the caller will be informed that the destination rover is currently unobtainable. If the rover is found the access control means will route the call through the telephone network to the exchange responsible for the appropriate base-station. The base-station announces the call, allocates a channel and the call proceeds.

As has previously been mentioned the access control means may be devolved into district and local controllers. The 'location' infor-

SPECIFICATION

Communications systems

This invention concerns a communications system comprising a number of base-stations connected to a network; in which portable transceivers (rovers) are capable, when within range, of communicating with any base-station for the purposes of sending and receiving calls over the network. Such systems may provide base-stations connected to, but remote from, exchanges of an existing telephone network; for instance in public places, homes and work places. The base-stations and rovers may conveniently have radio transceivers to enable intercommunication by means of short-range radio links.

In such systems it may often not be possible for a rover to send or receive calls, for instance: because it is out of range of any base-station, within range but screened, or just not functioning. The system, when handling incoming calls, is presented with the formidable problem of being able to detemine whether communication with any particular rover, at any time, is possible; if it is not, the system must react appropriately; and if it is, the system must locate the destination rover in order to direct the incoming call via the appropriate base-staion. It is expensive if signalling overhead to poll all possible base-stations in order to determine whether a rover is able to receive a call, yet the destination rover must be located if it is able to receive the call.

According to the invention there is provided a communications system comprising a plurality of base-stations connected to a network; a plurality of portable transceivers each capable of communication with any one of the base-stations when within range thereof; control means for recording the location of portable transceivers in which: each portable transceiver is arranged to transmit an identification signal; each base-station is arranged to forward received identification signals to the control means; and the control means is arranged upon receipt of an identification signal to record the identity of the base-station within range of which the portable transceiver originating that identification signal is located, where calls to portable transceivers can be directed to the appropriate base-station.

The invention will now be described, by way of example, with reference to the accompanying figures, in which:

Figure 1 shows part of a telephone network embodying the invention;

Figure 2 shows the progress of outgoing calls;

Figure 3 shows the progress of incoming calls.

Referring now to figure 1, part of a telephone network is shown. Exchanges 1 (the degree of hierarchy is not shown) interconnected by lines 6. Each exchange may support one or more base-stations 2. The base-stations 2 can communicate with any portable transceiver (rover) 3 that is within range (as shown).

Communication between the rovers 3 and the network is controlled by access control means. The access control means its preferably devolved, for example into dictrict controllers 5, and local controllers 4 associated as shown, with the exchanges 1, or, not shown, with the base-stations 2. The access control means may, or may not, mirror the structure of the telephone network.

Each base-station 2 has one or more radio transceivers, depending on its local environment, by which it may communicate to the rovers within its range. A base-station situated in a private house may need to transceive on only one radio channel with one single-channel rover, and it would require only one telephone line connected to the exchange. For handling two simultaneous calls, two radio channels and two telephone lines would be required. When located in a public, or semi-public, environment the base-station would be required to handle all the available radio channels (perhaps forty), and be able to allocate suitable channels for communication with single—or multi-channel rovers. Preferably such a base-station would be capable of allocating and re-allocating channels dynamically within calls; since one-channel rovers might have an overiding choice of channels. The multi-channel base-stations would not require the equivalent number of exchange lines as radio channels since concentrators enable a reduction of the number of lines depending on the expected traffic.

The rovers 3 are preferably pocket-size and powered by batteries, they have a keypad for the user to enter information. Each has a unique multi-digit identifier, part of which could be installed at manufacture by blowing links on a programmable logic array chip. This part of the identifier could include information about the radio channels that rover is able to use. Another part of the identifier, which could be installed later includes information identifying the rover's assigned 'home' base-station, that is, the base-station at the customer's favoured location, usually the billing point. A further part may be necessary to uniquely identify the rover.

The rovers could, in theory, be able to communicate on all the available radio channels, however, in practice this would have an undesirable effect on the complexity, size, power consumption and therefore cost of the rover. So each rover would preferably be allocated only, say, three or four (perhaps randomly selected) radio channels. This would reduce the cost factors but maintain enough flexibility to

any one of the preceding claims including means selectably operable to effect redirection of calls directed to a fixed telephone line to one of the portable transceivers.

19. A communications system according to claim 13 in which the redirection means is operable to redirect such a call to one, selectable by the calling party, of a group of portable transceivers.

20. A communications system substantially as herein described with reference to the accompanying drawings.

CLAIMS

Amendments to the claims have been filed or textually amended.

Claims 1 to 9, 13, 17, 19 above have been deleted or textually amended.

New or textually amended claims have been filed as follows:

1. A communications system comprising;

a plurality of base-stations,

a plurality of portable transceivers each capable of communication with any one of the base-stations when within range thereof, each such transceiver being assigned to a particular base-station,

a plurality of exchanges connected to a network and to the base-stations, and

control means for recording the location of portable transceivers comprising local control means associated with each exchange and a plurality of control centres each common to a plurality of exchanges,

in which: each portable transceiver is arranged to transmit an identification signal; each base-station is arranged to forward received identification signals to the control means; and the control means is arranged upon receipt of an identification signal to record the identity of the base-station within range of which the portable transceiver originating that identification signal is located, the local control means being arranged to store information identifying, in respect of each of the transceivers assigned to the base-stations connected to that exchange, which of those base-stations (if any) has received an identifying signal from that transceiver, whereby each exchange is operable upon receipt of a call for a transceiver to direct it to a base-station thus identified or, if no such base-station is identified, to transfer control to the control centre to which it is connected.

2. A communications system according to claim 1 in which the exchange is arranged in the event that no such station is identified to transmit to the caller an audible indication that a higher call charge will apply to the call, if successful.

3. A communications system according to claim 1 or claim 2 in which each portable transceiver is arranged only in response to operation of a switch to transmit the identification signal.

7. A communications system according to claim 4 or 5 in which the inhibiting means is located in a control centre or in a telephone exchange to which is connected a base-station to which the transceiver is assigned.

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